

We claim:

1. A method for creating an electronic communication, comprising executing the following operations in at least one data processing device:

- first retrieving data from at least one type of data source into a first electronic format using at least one first annotated schema;
- second retrieving data from the first electronic format into a second electronic format using at least one second annotated schema.

2. The method of claim 1, wherein the first electronic format comprises at least one XML document.

3. The method of claim 1, wherein the first electronic format comprises at least one value pair.

4. The method of claim 1, wherein the first and second retrieving are done using a same type of software engine applied first to the at least one type of data source and then to the first electronic format.

5. The method of claim 1, wherein the second electronic format belongs to the category of XML/EDI electronic document specification languages.

6. The method of claim 1, wherein the first annotated schema comprises at least one first annotated DTD and the second annotated schema comprises at least one second annotated DTD.

5 7. The method of claim 6, wherein the at least one second annotated schema comprises

- a single DTD for all possible document types within a single industrial electronic document specification language; and
- annotations for retrieving specifications for a desired document type from the first electronic format.

10 8. The method of claim 7, wherein the first and second retrieving are done using a same type of software engine applied first to the at least one type of data source and then to the first electronic format.

15 9. The method of claim 1, wherein the at least one type of data source comprises heterogeneous data bases.

10. The method of claim 1, further comprising using a GUI tool to create internal representations relating the second format to the at least one type of data source.

20 11. The method of claim 10, wherein the GUI tool can systematically organize a template from combining and merging multiple tables.

12. The method of claim 10, wherein the GUI tool can accept single annotations for certain repeatable constructs in the template, and can also replicate the repeatable constructs a fixed number of times for customized annotation.

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13. At least one data processing device comprising:

- at least one memory for storing code and data;
- at least one processor for performing the following operations using the least one memory
 - first retrieving data from at least one type of data source into a first electronic format using at least one first annotated schema;
 - second retrieving data from the first electronic format into a second electronic format using at least one second annotated schema; and
 - creating an electronic communication based on the at least one second annotated schema.

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14. The device of claim 13, wherein the first electronic format comprises at least one XML document.

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15. The device of claim 13, wherein the first electronic format comprises at least one value pair.

16. The device of claim 13, wherein the first and second retrieving are done using a same type of software engine applied first to the at least one type of data source and then to the first electronic format.

5 17. The device of claim 13, wherein the second electronic format belongs to the category of XML/EDI electronic document specification languages.

10 18. The device of claim 13, wherein the first annotated schema comprises at least one first annotated DTD and the second annotated schema comprises at least one second annotated DTD.

19. The device of claim 18, wherein the at least one second annotated schema comprises

- a single DTD for all possible document types within a single industrial electronic document specification language; and
- 15 • annotations for retrieving specifications for a desired document type from the first electronic format.

20 20. The device of claim 19, wherein the first and second retrieving are done using a same type of software engine applied first to the data sources and then to the first electronic format.

21. The device of claim 13, wherein the at least one type of data source comprises heterogenous relational databases.

22. The device of claim 13, further comprising using a GUI tool to create internal representations relating the second format to the at least one type of data source.

23. The device of claim 22, wherein the GUI tool can systematically organize a template from combining and merging multiple tables.

24. The device of claim 22, wherein the GUI tool can accept single annotations for certain repeatable constructs in the template, and can also replicate the repeatable constructs a fixed number of times for customized annotation.

25. A medium readable by a data processing device and embodying code for performing the following operations:

- first retrieving data from at least one type of data source into a first electronic format using at least one first annotated schema;
- second retrieving data from the first electronic format into a second electronic format using at least one second annotated schema; and
- creating an electronic communication based on the at least one second annotated schema.

26. The medium of claim 25, wherein the first electronic format comprises at least one XML document.

27. The medium of claim 25, wherein the first electronic format comprises at least one value pair.

28. The medium of claim 25, wherein the first and second retrieving are done using a same type of software engine applied first to the at least one type of data source and then to the first electronic format.

29. The medium of claim 25, wherein the second electronic format belongs to the category of XML/EDI electronic document specification languages.

30. The medium of claim 25, wherein the first annotated schema comprises at least one first annotated DTD and the second annotated schema comprises at least one second annotated DTD.

31. The medium of claim 30, wherein the at least one second annotated schema comprises

- a single DTD for all possible document types within a single industrial electronic document specification language; and
- annotations for retrieving specifications for a desired document type from the first electronic format.

32. The medium of claim 31, wherein the first and second retrieving are done using a same type of software engine applied first to the at least one type of data source and then to the first electronic format.

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33. The medium of claim 25, wherein the at least one type of data source comprises heterogenous relational databases.

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34. The medium of claim 25, further comprising using a GUI tool to create internal representations relating the second format to the at least one type of data source.

35. The medium of claim 34, wherein the GUI tool can systematically organize a template from combining and merging multiple tables.

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36. The medium of claim 34, wherein the GUI tool can accept single annotations for certain repeatable constructs in the template, and can also replicate the repeatable constructs a fixed number of times for customized annotation.

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37. At least one medium embodying code readable by at least one data processing device, the code comprising

- a universal schema adapted to create all possible document types suitable for use with a single electronic document specification language;

- annotations adapted to guide retrieval of data from at least one type of data source to specify a particular output document in accordance with the universal schema.

38. The medium of claim 37, wherein the single electronic document specification language is of the XML/EDI family.

39. The medium of claim 37, wherein the universal schema is a DTD.

40. The medium of claim 37, wherein the universal DTD is annotated with recursive constructs.

41. The medium of claim 37, wherein the universal DTD attaches unique labels to corresponding intermediate XML document or value pairs.

42.. A method for depositing data into at least one type of data source, the method comprising executing the following operations in a digital data processing device:

- receiving a specification for deposit;
- processing the specification in accordance with an annotated schema; and
- responsive to the processing, depositing data in at least one type of data source in accordance with a local format of that source.

43. The method of claim 42, wherein the annotated schema comprises an annotated DTD.

44. The method of claim 42, wherein the specification for deposit comprises an XML document.

5 45. The method of claim 42, wherein the operations further comprise determining whether the annotated schema is reversible in view of the specification for deposit.

10 46. The method of claim 45, wherein the operations further comprise, responsive to a determination that the annotated schema is not so reversible, creating a revised annotated schema that is reversible, so that the data is depositable in accordance with the revised annotated schema.

47. The method of claim 46, wherein

- the annotated schema and the revised annotated schema each comprise a respective DTD;
- the operations further comprise
 - developing a revised XML document for display to the user responsive to the revised annotated schema; and
 - depositing the data in accordance with annotations of the revised annotated schema.

48. The method of claim 42, wherein the operations further comprise propagating the deposit to a join union of the specification.

49. The method of claim 42, wherein the processing comprises

- first processing the specification in accordance with a universal annotated schema adapted to all document types supported by a given industrial electronic document specification language, in order to convert the specification in to a first local format; and
- second processing the first local format in accordance with a local annotated schema to convert the first local format to a second local format.

50. The method of claim 49, wherein

- the universal annotated schema comprises a universal annotated DTD;
- the first local format comprises an XML document or at least one value pair;
- the local annotated schema comprises a local annotated DTD or local annotated table; and
- the second local format comprises multiple relational databases.

51. The method of claim 42, wherein

- the operations further comprise
 - determining whether the annotated schema is reversible in view of the specification for deposit;

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- responsive to a determination that the annotated schema is not so reversible, creating a revised annotated schema according to which the specification for deposit is reversible;
 - the processing includes
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- first processing the specification in accordance with a universal annotated schema adapted to all document types supported by a given industrial electronic document specification language, in order to convert the specification into a first local format; and
 - second processing the first local format in accordance with the revised annotated
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- schema to convert the first local format to a second local format;
 - depositing includes propagating the deposit to a join union of the specification.

52. The method of claim 51, wherein

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- the universal annotated schema comprises a universal annotated DTD;
 - the first local format comprises an XML document or at least one value pair;
 - the local annotated schema comprises a local annotated DTD or local annotated table;
- and
- the second local format comprises multiple relational databases.

20 53. At least one data processing device comprising:

- at least one memory for storing data and code;

- at least one processor adapted to perform the following operations in conjunction with the at least one memory:
 - receiving a specification for deposit;
 - processing the specification in accordance with an annotated schema; and
 - responsive to the processing, depositing data in at least one type of data source in accordance with a local format of that source.

54. The device of claim 53, wherein the annotated schema comprises an annotated DTD.

55. The device of claim 53, wherein the specification for deposit comprises an XML document.

56. The device of claim 53, wherein the operations further comprise determining whether the annotated schema is reversible in view of the specification for deposit.

57. The device of claim 56, wherein the operations further comprise, responsive to a determination that the annotated schema is not so reversible, creating a revised annotated schema that is reversible, so that the data is depositable in accordance with the revised annotated schema.

58. The device of claim 57, wherein

- the annotated schema and the revised annotated schema each comprise a respective DTD;
- the operations further comprise
 - developing a revised XML document for display to the user responsive to the revised annotated schema; and
 - depositing the data in accordance with annotations of the revised annotated schema.

59. The device of claim 53, wherein the operations further comprise propagating the deposit to a join union of the specification.

60. The device of claim 53, wherein the processing comprises

- first processing the specification in accordance with a universal annotated schema adapted to all document types supported by a given industrial electronic document specification language, in order to convert the specification in to a first local format; and
- second processing the first local format in accordance with a local annotated schema to convert the first local format to a second local format.

61. The device of claim 60, wherein

- the universal annotated schema comprises a universal annotated DTD;
- the first local format comprises an XML document or at least one value pair;

- the local annotated schema comprises a local annotated DTD or local annotated table;
and
- the second local format comprises multiple relational databases.

5 62. The device of claim 53, wherein

- the operations further comprise
 - determining whether the annotated schema is reversible in view of the specification for deposit;
 - responsive to a determination that the annotated schema is not so reversible,
10 creating a revised annotated schema according to which the specification for deposit is reversible;
- the processing includes
 - first processing the specification in accordance with a universal annotated schema adapted to all document types supported by a given industrial electronic document
15 specification language, in order to convert the specification into a first local format; and
 - second processing the first local format in accordance with the revised annotated schema to convert the first local format to a second local format;
- depositing includes propagating the deposit to a join union of the specification.

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63. The device of claim 62, wherein

- the universal annotated schema comprises a universal annotated DTD;

- the first local format comprises an XML document or at least one value pair;
- the local annotated schema comprises a local annotated DTD or local annotated table;
- and
- the second local format comprises multiple relational databases.

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64. A medium, readable by at least one data processing device embodying code for performing the following operations:

- receiving a specification for deposit;
- processing the specification in accordance with an annotated schema; and
- responsive to the processing, depositing data in heterogeneous data sources in accordance with a local format of that source.

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65. The medium of claim 64, wherein the annotated schema comprises an annotated DTD.

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66. The medium of claim 64, wherein the specification for deposit comprises an XML document.

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67. The medium of claim 64, wherein the operations further comprise determining whether the annotated schema is reversible in view of the specification for deposit.

68. The medium of claim 64, wherein the operations further comprise, responsive to a determination that the annotated schema is not so reversible, creating a revised annotated schema that is reversible, so that the data is depositable in accordance with the revised annotated schema.

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69. The medium of claim 68, wherein

- the annotated schema and the revised annotated schema each comprise a respective DTD;
- the operations further comprise
 - developing a revised XML document for display to the user responsive to the revised annotated schema; and
 - depositing the data in accordance with annotations of the revised annotated schema.

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70. The medium of claim 64, wherein the operations further comprise propagating the deposit to a join union of the specification.

71. The medium of claim 64, wherein the processing comprises

- first processing the specification in accordance with a universal annotated schema adapted to all document types supported by a given industrial electronic document specification language, in order to convert the specification in to a first local format; and

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- second processing the first local format in accordance with a local annotated schema to convert the first local format to a second local format.

72. The medium of claim 71, wherein

- the universal annotated schema comprises a universal annotated DTD;
- the first local format comprises an XML document or at least one value pair;
- the local annotated schema comprises a local annotated DTD or local annotated table;
- and
- the second local format comprises multiple relational databases.

73. The device of claim 64, wherein

- the operations further comprise
 - determining whether the annotated schema is reversible in view of the specification for deposit;
 - responsive to a determination that the annotated schema is not so reversible, creating a revised annotated schema according to which the specification for deposit is reversible;
- the processing includes
 - first processing the specification in accordance with a universal annotated schema adapted to all document types supported by a given industrial electronic document specification language, in order to convert the specification into a first local format; and

- second processing the first local format in accordance with the revised annotated schema to convert the first local format to a second local format;
- depositing includes propagating the deposit to a join union of the specification.

5 74. The device of claim 73, wherein

- the universal annotated schema comprises a universal annotated DTD;
 - the first local format comprises an XML document or at least one value pair;
 - the local annotated schema comprises a local annotated DTD or local annotated table;
- and
- the second local format comprises multiple relational databases.